

California Environmental Protection Agency

 **Air Resources Board**

Residential Cooking Exposure Study Finds Unhealthful Levels

◆ INTRODUCTION

Research scientists recently completed an ARB-funded study that showed very high levels of several pollutants in indoor air during different types of cooking activities. The levels measured for some cooking activities exceeded health-based standards and guidelines, and could pose a potential risk to home occupants, especially susceptible groups of the population such as young children and the elderly. This is the first comprehensive study of indoor air pollutant exposures from a wide variety of cooking activities in a home. The study was conducted by ARCADIS Geraghty & Miller, Inc.

◆ METHODS

Researchers measured the levels of airborne particles and pollutant gases during cooking in a test home in northern California. They tested the indoor air quality impacts of 32 cooking activities, using both gas and electric ovens and stovetops. Tests were conducted using both typical and realistic “worst case” conditions.

◆ PARTICLES

- Several types of cooking activities produced very high levels of particles in the kitchen and other rooms of the house. Levels often exceeded ARB's indoor air quality guideline level and ambient air quality standard for PM10 of 50 micrograms per cubic meter for one day. (PM10 includes all particles that are 10 microns or less in size, which is about one-sixth the diameter of a human hair.) Kitchen levels of PM10 ranged from 60 to 1400 micrograms per cubic meter during cooking activities with the gas stove, including broiling fish, baking lasagna, frying tortillas, stir-frying and cooking a fried chicken dinner.
- The self-cleaning cycle of the gas stove produced the highest pollutant levels by far -- the maximum level of PM10 was over 3,600 micrograms per cubic meter over several hours.
- Oven cleaning in the electric stove also produced high levels of particles in the house: nearly 1,000 micrograms per cubic meter of PM10. Surprisingly, cooking with the electric stove also produced very high pollutant levels indoors in some cases. Frying tortillas and stir-frying on an electric stove actually produced higher levels of PM10 than on a gas stove: 1200-1300 micrograms per cubic

meter using the electric stove vs. 200-800 micrograms per cubic meter on the gas stove. This increase may have been due to food spillage on the electric burners or reduced temperature control with the electric stove.

◆ **NITROGEN DIOXIDE**

- Nitrogen dioxide levels also increased during cooking activities with the gas stove. Making a fried chicken dinner produced average indoor nitrogen dioxide levels of up to 400 parts per billion, which is well over ARB's indoor air quality guideline and ambient air quality standard of 250 parts per billion for one hour. Other cooking tasks such as broiling fish, baking lasagna, frying tortillas, and stir-frying produced average indoor nitrogen dioxide levels ranging from 30 to 170 parts per billion.
- Oven cleaning in a gas stove also yielded very high levels of indoor nitrogen dioxide, which exceeded 400 parts per billion. Again this is well above ARB's indoor air quality guideline and ambient air quality standard of 250 parts per billion for one hour.

◆ **FORMALDEHYDE**

- Indoor formaldehyde levels exceeded 400 micrograms per cubic meter (equal to about 325 parts per billion) during oven cleaning in a gas stove. This exceeds the California Office of Environmental Health Hazard Assessment's Acute Reference Exposure Level (REL) guideline of 94 micrograms per cubic meter for one hour, and exceeds ARB's indoor guideline action level of 100 parts per billion as well.
- With electric ovens, use of the oven cleaning cycle and certain cooking activities, such as fish broiling, similarly produced significant increases in levels of indoor formaldehyde. Formaldehyde levels ranged from 130 to 420 micrograms per cubic meter, which exceed the health-based guidelines mentioned above. The formaldehyde may have come from overcooking of food and/or burning of food residue on surfaces.

◆ **PAHs**

- The researchers found that peanut oil and olive oil from grocery store shelves had much higher levels of polycyclic aromatic hydrocarbons (PAHs) than did corn, soy, and canola oils. However, the airborne PAH concentrations in the house were relatively low during cooking. PAHs are by-products of combustion and many have been identified as carcinogens.

◆ CARBON MONOXIDE

- Indoor carbon monoxide levels were moderately elevated over several hours during oven cleaning, exceeding ARB's indoor air quality guideline and the State ambient air quality standard of 9 parts per million for an 8-hour average.
- Indoor carbon monoxide levels averaged 1 to 5 parts per million during all other cooking activities. These levels are below health-based standards and guidelines, but could contribute to unhealthful levels when background carbon monoxide levels are elevated because of other indoor and outdoor pollutant sources.

◆ REDUCING EXPOSURES

The researchers also tested practical ways to reduce exposures during cooking.

- Use of the range hood exhaust reduced pollutant levels in some cases.
- Using vertical side shields along with the range hood exhaust over the stove was most effective in reducing indoor pollutant levels.
- Microwave oven cooking produced much lower particle levels than conventional stoves.

◆ CONCLUSIONS

- **Cooking can easily produce indoor pollutant levels that exceed health-based standards and guidelines for particles, nitrogen dioxide, formaldehyde, and carbon monoxide. The pollutants can quickly spread throughout the house.**
- **To reduce exposures of residents to pollutants during cooking and oven-cleaning, families should take the following precautions:**
 1. Have gas stoves cleaned and properly adjusted annually for carbon monoxide and gas pressure by a trained professional.
 2. Use a low-noise range exhaust hood that is vented to the outdoors and that does not cause backdrafting of other combustion appliances.
 3. Use heat-proof side shields along with the exhaust hood, to more effectively remove pollutants, especially during heavy use of the oven or broiler.
 4. Avoid over-heating food and spilling food on burners. Clean spills and spatters before the next use.
 5. Use the self-cleaning oven cycle only when the house is not occupied and is well ventilated, especially during the first hour or two.
 6. Consider microwaving food when possible.

For further information on reducing indoor pollutant levels, see ARB's Indoor Air Quality Guidelines at <http://www.arb.ca.gov/research/indoor/indoor.htm>, or call (916) 322-8282 for free copies and supplements.